Austin Energy

Review of Strategic Plan for Local Solar in Austin

Prepared by DNV KEMA Energy & Sustainability

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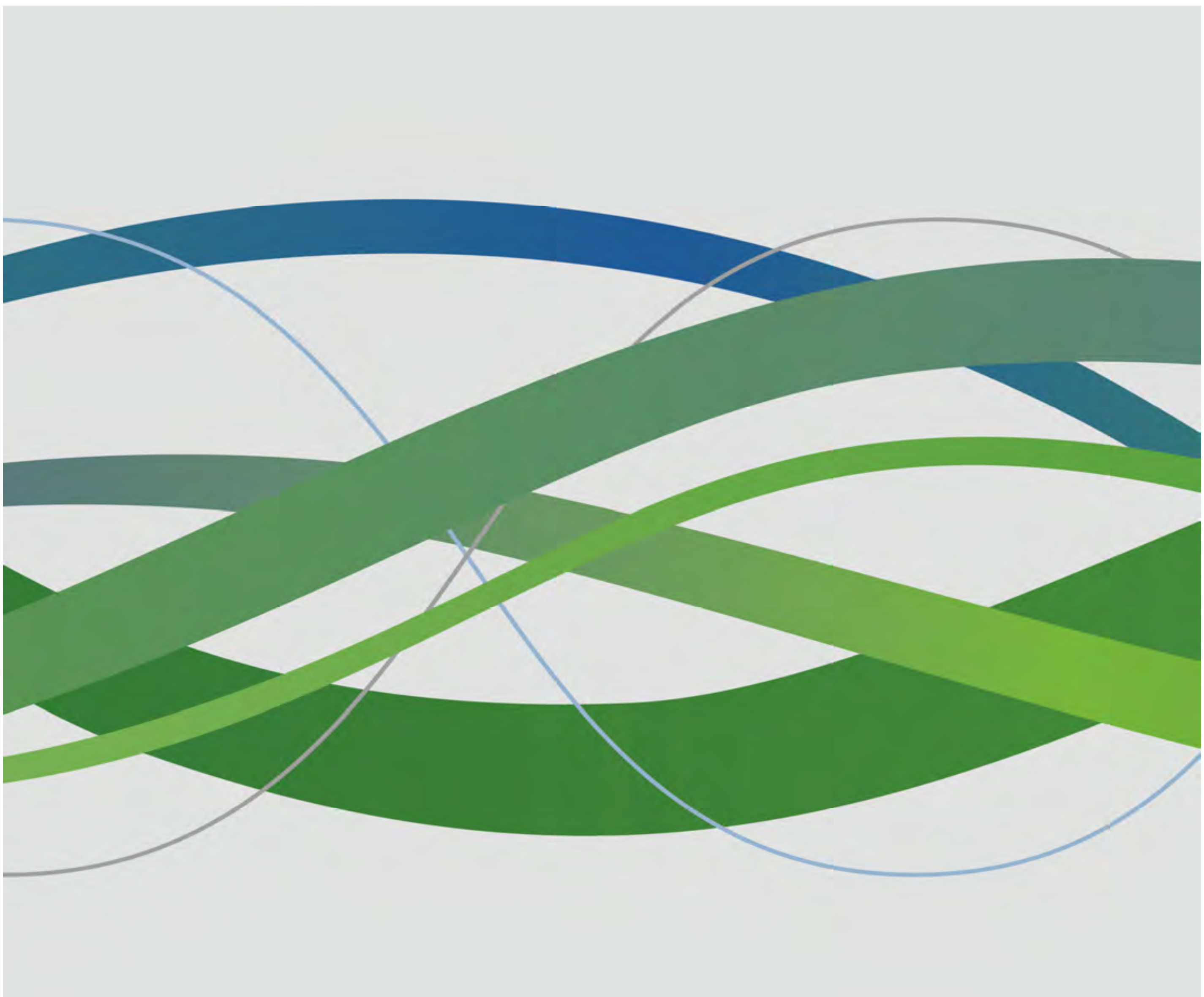
FINAL REVISED REPORT



Category	Assumption	DNV KEMA Response	Comments
Installed Cost	$3.90/Wdc with 6-7% Annual Decline	Reasonable	Ryan Wiser et al, in their July 2013 report titled "Tracking The Sun VI," indicate residential PV costs of $3.90/W in Texas in 2012.[5] The declining price trend of 6-7% per year is reasonable and consistent with both an industry growth rate of 25% and a commonly anticipated technology "progress ratio," (price-volume learning curve term) of 0.82.[6] [7]
Production Factor	1,300 kWh/kWac	Conservative	A production factor of just 1,300 kWh/kWac would be viewed as conservative by DNV KEMA. In the Austin climate, a typical but sub-optimal residential system could reasonably be expected to receive 5.2 peak sun hours per day per NREL's 30-year average. At a typical modern performance ratio of 0.75 for a modestly shaded and intermittently dusty residential system, this would amount to a production factor, or specific yield, of 1,423 kWh/kWp. Converting this to an ac-based capacity under warmer real field operational conditions would likely amount to a derating factor of about 0.85, not 0.95, making the expected production factor about 1,674 kWh/kW-ac. (A modern residential inverter might have an efficiency of 95%, but when coupled with the inevitable temperature, wire, and mismatch losses, the dc-to-ac conversion is about 85%.) The projected yield of 1,674 kWh/kW-ac is 29% higher than the LSAC production forecast anticipates, and would represent that much more of an energy contribution at no additional rebate cost. The higher production would increase the cost of a PBI-based incentive program, though such incentives are not common among residential installations.
Policy Impact	Did not address the impact from potential federal ITC changes in 2016	Optimistic	Based on PV cost and installed capacity trends over the past five years, and on the generally declining incentive structures in numerous states, it seems likely that the industry won't need to lobby heavily for a Federal 30% tax credit extension. While not wholly unpopular even among non-industry sectors, the political backlash of continued Federal generosity in the wake of the Solyndra case and similar loan failures may not be practical to expect. A Federal tax credit of 10% would seem to be more in line with past support. If so, there would be a drop-off of several percent in residential PV market capacity unless that discontinuity were matched by an equal boost at the state or local level, neither of which would seem likely for Austin Energy. On that basis, the residential forecast per LSAC would seem unexpectedly optimistic for growth between 2016-17, as the LSAC trend shows an 18% increase that year, with just 2-5% program increases in the three prior years.

Table 7: Evaluation of Residential Assumptions

While the LSAC report's estimated current and future installed PV costs are defensible, the report acknowledged that it did not model the expected decrease in the federal tax credit. The

[5] Wiser, Ryan et al. "Tracking the Sun VI". June, 2013

[6] Margolis, Robert. "Photovoltaic Technology Experience Curves and Markets". March, 2013

[7] Bowden, Stuart et al. Moore's Law of Photovoltaics. May, 2010

3.1.2 Commercial Solar

LSAC's plan calls for a goal of 55 MW of commercial solar by 2020. Many of the assumptions made by the committee for commercial solar are similar to those made for residential. This section will review the rigor of the major assumptions, most of which are embedded in the Table 9, below.

Commercial									
	2012	2013	2014	2015	2016*	2017	2018	2019	2020
MWac (Annual)		1	4	4.5	7	4.4	6.1	14.3	12.8
MWac (cumulative)	1.4	2.4	6.4	10.9	17.9	22.4	28.4	42.7	55.5
Installed costs ($/Wdc)	$3.30	$3.05	$2.80	$2.60	$2.40	$2.20	$2.00	$1.85	$1.60
Installed Cost Annual Decrease		8%	8%	7%	8%	8%	9%	8%	14%
Installed costs Post ITC ($/Wdc)	$2.31	$2.14	$1.96	$1.82	$2.40	$2.20	$2.00	$1.85	$1.60
Annual PBI Budget ($M)	$0.14	$0.14	$0.13	$0.11	$0.10	$0.08	$0.06	$0.04	$0.01
Amt.: net projects ($M)		$0.21	$0.75	$0.75	$1.00	$0.50	$0.50	$0.75	$0.25
Assumes 10 year PBI contracts									
Production factor is assumed to be 1,276 kWh/kWdc, per PVWatts v.1 modeled at 5% tilt, due south orientation in Austin. Conversion from kWh/kWdc to kWh/kWac assumes a DC-AC conversion factor of 0.85.									
Annual PBI commitment costs peak at $5M/yr in 2020 and 2021 and taper to $0/yr in 2030.									
Total Incentives (2013-2020): $24.00M After 2020: $25.71									
Total (through 2030): $49.71									
NPV5% of Incentives (2013-2020): $18.29M NPV5% of Incentives (through 2030): $33.02M									
* The current federal investment tax credit (ITC) is scheduled to decrease from 30 percent to 10 percent in 2016. Modeling does not assume the effect of this expiration on nominal and after-tax costs.									

Table 9: Commercial Summary Table Adapted from LSAC Strategic Report

A summary of DNV KEMA's review of LSAC's assumptions is presented in the table below.

Category	Assumption	DNV KEMA Response	Comments
Installed Cost	$3.30/Wdc and 7%-14% annual decline	Slightly Optimistic	Wiser's 2013 Lawrence Berkeley report, the same source used to verify the exact price cited in the LSAC report for Texas residential PV cost in 2012, also lists a 2012 medium-size commercial PV cost of $4.50/Wp in Texas, so the LSAC cost figures seem considerably more optimistic than that one trusted source would suggest.[8] However, for commercial PV greater than 100 kW, for which no Texas system data were reported due to an insufficient sample size, there were states that reported costs in the $3.30/W range. For example, Colorado commercial systems averaged $3.20/W, so the LSAC quote is not implausibly optimistic.
Production Factor	1,276 kWh/kWac	Conservative	The specific yield for a commercial rooftop system in Austin, even for a popular very low-slope type, would likely be well in excess of 1,276 kWh/kWac. Depending on the value used to convert kWac to kWp, a yield of 1,276 would translate to less than 1,100 kWh/kWp, an implausibly poor result for this climate. DNV KEMA would expect a typical low-slope yield to be more in line with the product of a solar resource of 5 peak hours per day x 365 days/yr x 0.80 performance ratio for modern, maintained and unshaded commercial systems, for a dc yield of 1,460 kWh/kWp. This is the more common nomenclature used in the industry, but if that value were converted to an ac basis using a conversion factor of 0.85, the corresponding ac-based yield would be 1,718 kWh/kW-ac. This is 35% above the LSAC projection and is worthy of further study and clarification. In PVWatts, users are tasked to apply a derate factor that accounts for all losses other than temperature. The default derate factor is 0.77, which was appropriate for older systems but is widely viewed as too conservative for contemporary systems. Modern PV features true-to-nameplate module output, whereas manufacturers formerly routinely overstated actual output by 5%. Modern inverters operate in the 95-97% efficiency range, while the older PVWATTS guideline assumed efficiencies of about 90-92%. These two changes alone mean most modern PV systems should achieve annual performance ratios of 75-80%, when older systems typically hovered around 70%. PVWatts is a fine tool, but its inputs must be user-adjusted to reflect current practices and expectations, and generally, these expectations are now several percent better than when the program was introduced over 15 years ago.
Policy Impact	Did not address the impact from potential federal ITC changes in 2016	Optimistic	See Residential Section

Table 10: Evaluation of Commercial Assumptions

[8] Wiser, Ryan et al. June, 2013

The table below details the assumptions made in the LSAC report and DNV KEMA's evaluation of them.

Category	Assumption	DNV KEMA Response	Comments
Solar Contract Cost	$0.08/kWh to $0.06/kWh	Reasonable (see ITC comment)	The reduced PPA of 8 cents/kWh would only look attractive if the investor were able to realize the 30% tax credit (or its equivalent Federal 1603 Grant), and if the cost were $2/W, and the location was a sunnier spot such as El Paso, and if the PPA term were 30 years. Under those terms, a favorable B/C ratio of 1.09 may be realized. At 20 years, this doesn't seem to pencil out favorably - B/C ratio dips slightly below 1.0. At $2.50/W, the B/C ratio dips to 0.91 and is far too low to justify the investment. The financing terms of 20% equity, 80% debt, 8% loan and 9% discount rate as applied above were used for this analysis as well.
Production Factor	2,250 kWh/kWac	Conservative	The production factor of 2,250 is consistent with DNV KEMA estimates for tracking system output in El Paso on a dc basis, that is, 2,250 kWh/kWp is a reasonable estimate. On an ac basis, the stated value is viewed by DNV KEMA as conservative, since a value of over 2,600 would be expected on an ac basis for this optimal southwest tracker example. Throughout, it appears there may be a mismatch of labeling on the production factor units, as 2,250 kWh/kWp is a common high-end yield that has been proven in the field, and, as noted above, yields are most commonly expressed in units of kWh/kWp.
DC-AC Conversio n Factor	DC-AC Conversion factor of 0.90	Reasonable	In general, the more generous assumption of a 0.90 conversion is probably justified for best-case contemporary utility scale systems. Most should be able to achieve the 0.90 dc to ac conversion because they feature very high efficiency inverter/transformer combinations of around 0.96. Depending on what other loss factors are considered in the conversion, this leaves plenty of calculation allowance for small but cumulative effects such as clipping, wire resistance, imperfect maximum-power-point tracking, and mismatch, which collectively would lessen the conversion factor from 0.96 but still enable it to surpass 0.90. The one large unknown in this discussion is temperature. If temperature is intended to be included in this dc to ac conversion, then 0.90 is not likely to be attained. Temperature losses alone would be in the 8% range in most southwest locations. That consideration alone would drop the overall dc to ac conversion factor back into the mid-80 percentile range. The reasonableness of this and other conversion and conventions is entirely dependent on the terms that lumped within the conversion.
Installed Costs	$2.50/W	Slightly Conservative	Although a reasonable cost assumption, as noted above, at $2.50/W, the investment does not look attractive, even in an optimal southwest location such as El Paso. At this cost, a higher PPA would be needed: at least 10 cents/kWh for 20 years.

Table 15: Evaluation of Other Utility Scale Assumptions

Although not addressed in the LSAC report, Austin Energy may also wish to consider the cost impacts from ERCOT settlement of non-local generation. Such an analysis is beyond the scope of this assessment and will depend on the nodal location of the procured other utility scale solar.